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Design of Compact and Cost-effective Automatic Sanitizer Dispenser Machine

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Abstract: This paper deals with design of compact and cost effective automatic sanitizer dispenser machine washing your hands is the most effective way to prevent the spread of germs; however, individuals do not always have the means or the patience to adhere to the entire procedure of washing as given by the Centre for Disease Control. A make-shift way of also killing germs on our hands is to sanitize them with an FDA approved sanitizer. Our design project goal was to design a smart sanitizer dispenser prototype. The main purpose of this prototype is to help the customers, staff and other officials use the sanitizer without coming in contact with the prototype. It is an easy way of sanitizing without infecting anyone coming after or being affected from the person before you. This kind of prototypes is very crucial during the time of pandemic as the safety of the workers is of very high importance. Not having such a prototype may cause the spreading of germs, bacteria or viruses from one person to another. The smart sanitizer dispenser could solve such problems thus killing the cause before it starts to spread like wildfire. With this prototype you need not worry about manually giving a sanitizer to individuals. The owner will be notified as and when the prototype will need a refill. With this you need not worry about the transmission of microorganisms from one person to another thus ensuring the safety of the people. This touch free unit uses an IR sensor to detect the presence of an object (hand) and then dispenses a certain amount of sanitizer enough to sanitize one person's hands at a time.
Keywords: Automatic Sanitizer Dispenser; Microcontroller; Touch free

Introduction: Hygiene is an important aspect in day to day life to prevent any spread of disease to which us humans are most vulnerable to. Most of the infections rapidly spread by contaminating the surfaces in the environment due to the microorganisms such as germs which facilitate the transfer of different types of diseases. When these come in contact to the body parts and if they are successful to enter the body of the victim through any means of eyes, mouth, or nose, it can disrupt the system, sometimes being fatal. Since chances of spreading are mostly based on contact to contact, i.e Hand to surface or vice-versa, it is important for us to maintain hygienic habits by regularly washing our hands with soaps. But it is not practical to do it every time when dwelling in the outside world, hand sanitization with the help of sanitizers prove to be an effective way to minimize the risk of getting contaminated. Whilst the world is battling against the COVID-19 outbreak, I have come up with an alternative approach of sanitation without any physical contact with the dispenser. According to the Centre of Disease Control (CDC) certain steps have to be taken to clean and prevent the spread of these minute organisms.

1. Washing hands with soap and warm running water.
2. Hands should be washed for at least 20 seconds and should be cleaned properly from wrist to fingertips.
3. Hands should be rinsed in the running water.
4. While the water is still running, hands should be dried with a single use towel.
5. The faucet should be cleaned with a single use towel to prevent re-contamination.

Instead of using water and soap, a small amount of sanitizer serves the purpose. The alcohol used in it kills germs. This project is based on the sanitize dispenser with a sensor to wash hands preventing re-contamination and maintaining hygiene.

Literature Survey: There are several types of automatic systems available in the market to clean hands without any physical contact with the dispenser, that uses proximity sensors mostly based on infrared (IR) light to detect the presence of hands. [1]Completely touch-free system controlled by a fully programmed circuit that runs a 20 second hand wash and dry cycle upon motion sensors being triggered. [2] Development of the automatic faucet using Interaction Design process to carefully consider the usability of the product that meet the standard hand-wash procedure as well. [3] An automatic hand washing and drying machine for automatically washing and drying the hands and, optionally, moisturising the hands. Almost all dispenser systems designs above are based on water and soap based solutions which make them impractical to be installed at all places, hence using a sanitizer based dispenser overcomes this issue.

The systems available in the market are more complex and consist of many mechanical parts thereby increasing cost a lot. Some of them in the form of an integrated basin, which needs to be assembled as a complete basin system. Also the size and weight of these systems is quite large. Whereas the proposed system

comes as a much simple and small plug and play package thereby making it easy to install and use. This is designed for a simpler solution of cleaning hands instead of buying the whole package of hand washing system. Simplicity of the proposed system makes it economically feasible. The proposed system takes the idea of automatic Hand cleaning system to the next level as it provides practicality and functions that are not included in other automatic hand cleaning dispensers. The system will also notify the user with the system built in indicator when the sanitizer solution in the container is over.

Design Methodology

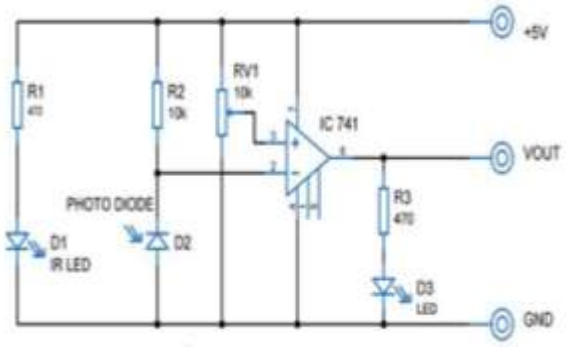

Fig.1 Circuit diagram for the project

The main components used in the design of sanitizer dispenser machine are briefly explained below:

Resistors: Resistors are two-terminal passive electrical components and are always present in electronic equipment. One way of classifying them can be as fixed and variable resistors. In fixed resistors, the resistance changes to a small degree due to voltage, temperature or time, whereas a variable resistor is used to adjust circuit elements (voltage divider or adjust volume).Resistors also are implemented within integrated circuits.

IR Transmitter (IR LED): An IR LED or infrared emitting diode emits infrared rays which ranges from 700 nanometers to 1 millimetre in wavelength. Different IR LEDs produce IR light of differing wavelengths, similar to different LEDs produce light of variouscolours. Infra-red LEDs are constantly on and run at 1.5 Volts and about 20 milli-Amperes.

IR receiver Photodiode: A Photodiode generates voltage only when exposed to infrared light. This device collects the light from the IR LED and generates voltage. The photodiode generates 0.22 (value A) Volts when the beam of light from the IR LED to the photodiode is uninterrupted and (value B) 0.18 volts when it is interrupted (due to background IR radiation).

LM741 Operational Amplifier: The LM741 IC consists of only one op-amp. These amplifiers do not latch-up on exceeding the common mode range. It is provided with a short-circuit protection and protects from overloading on the input and output. It has a large common-mode rejection ratio and differential voltage range and also is free from oscillation. The minimum, normal and maximum power consumption is ±10V, ±15V and ±20V respectively. These specifications make the LM741 Op-Amp nearly ideal.

LED: LEDs show the user that the IR Sensor has recognised the presence of a foreign object (hand) and is ready to dispense the sanitizer, as well as to dress the prototype up.

DC Pump: Mini DC - Submersible Pump : 3 to 12 V operation.

General Purpose Transistor (TIP42C): The TIP42C PNP transistor is an Epitaxial Silicon Transistor Characteristics: 1. Medium Power Linear Switching Applications 2.Complement to TIP41 Series

USB Cable: The USB is only used for the purpose of providing a voltage source to the circuit. First, the male end is harvested from any redundant system. Once the wire is stripped it reveals 4 wires: red, black, green, white. Of these we only need the red and the black as the green and white are data lines and we have no use of those in our circuit.

BOTTOMLINE: This device is extremely simple in nature. It does not attempt to perfect hand-washing, but only to allow users to maintain hygiene in locations and situations where that is not a typical option. This device is more similar in nature to our device, which is more focused on public use than on enforcing regulated practices in commercial applications.

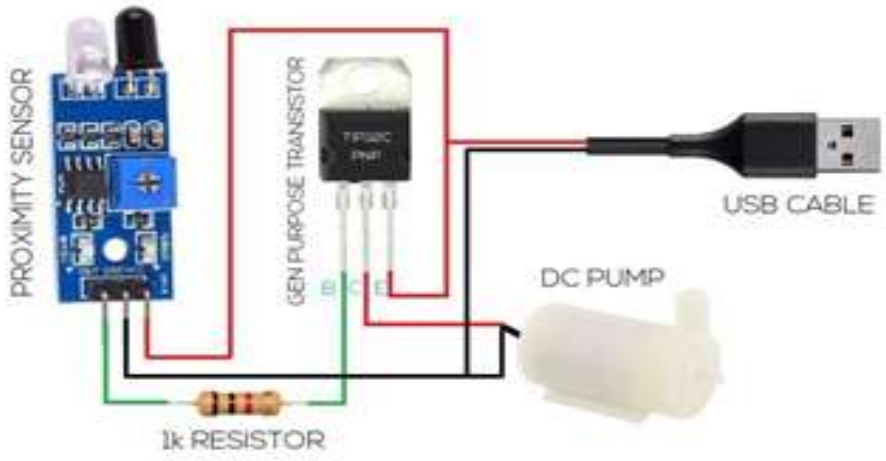

Fig.2 Component Setup for project

The LED-based motion sensor consisted of a photodiode and an infrared LED. When the light from the LED no longer reached the photodiode, the photodiode stopped putting out voltage and cued our system to being working. This switch activates a fluid pump which pushes a cleaning solution into the nozzles from the reservoir. This system was not optimal because it relies on two components, instead of more complex systems that simply have one part that actually senses motion in a field, but due to price limitations, this option was considered adequate for a prototype. In a full-fledged device we would want a better motion sensor that did not rely on a beam of light, but rather other proximity sensing technology. These sensors are more expensive than the entire device, but they are also much more consistent and provide a lot more longevity than the device. Due to our limited budget, we did not use a more advanced sensor in our prototype.

Microcontroller based design to indicate the presence of sanitizer solution in the container:

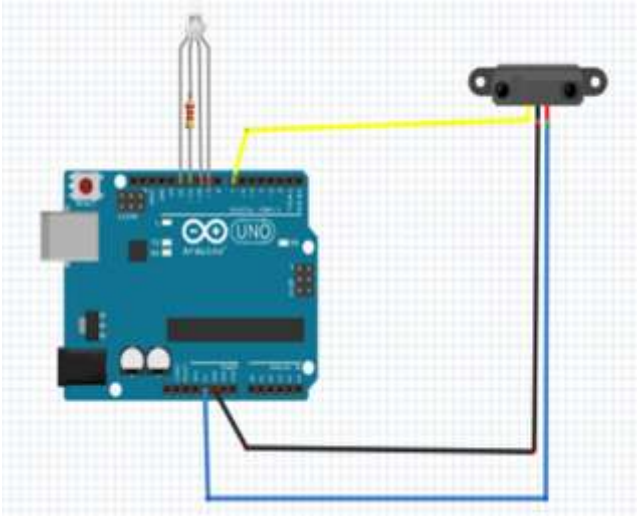

Fig.3 Microcontroller based design

An infrared(IR) sensor is used to detect the presence of sanitizer solution in the container by placing the sensor in the container at the bottom, this signal is sent to Arduino Uno microcontroller which will in turn change the colour of RGB LED and will notify the owner when the sanitizer solution in the container is over. A RGB LED is used to indicate whether the solution is present in the container. If sanitizer solution is present in

the container RGb LED will glow green, indicating the user that the system is ON and ready to use. If sanitizer solution is not present in the container RGB LED will glow red indicating the user that the system is not in operation and it needs a refill.

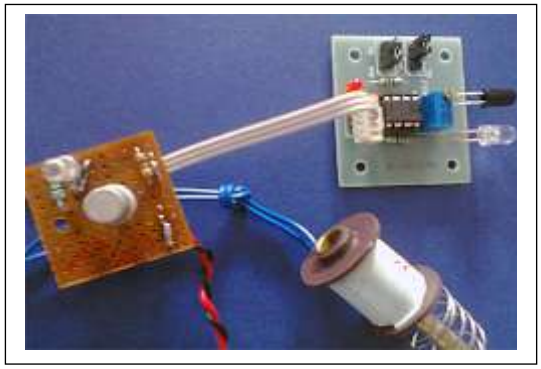

Fig .4 Prototype of the project

KI-CAD Results:

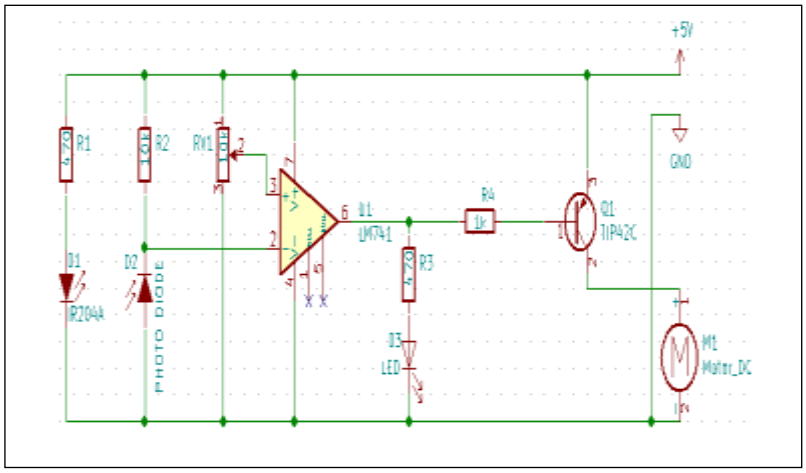

Figure 5. Schematic diagram of the circuit in Ki-CAD

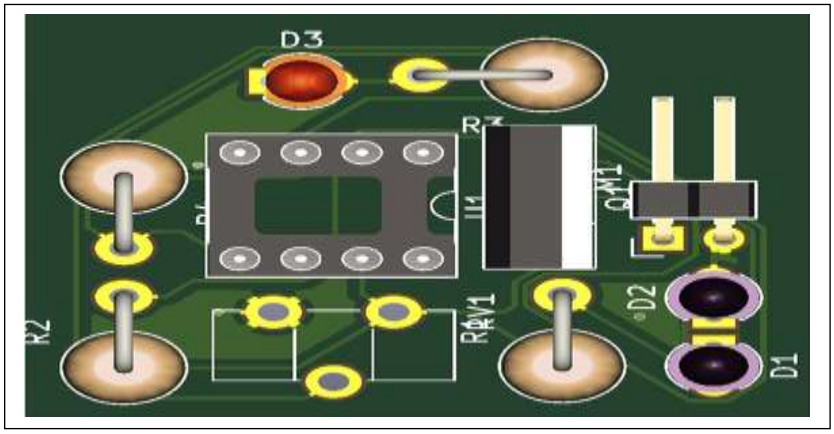

Figure 6. PCB 3D Model

Once the PCB layout is ready, we have to work on the hardware PCB design. To proceed with the hardware PCB design, first the gerber files are created, these gerber files can be utilized to print the actual signal routes on the PCB Board . This process can be done at home or it can also sent to the companies with all

the gerber files attached , making PCB ready at home is much simpler and results in low cost but if the design involves many complex components then industrial PCB board routing and fabrication is the only option .

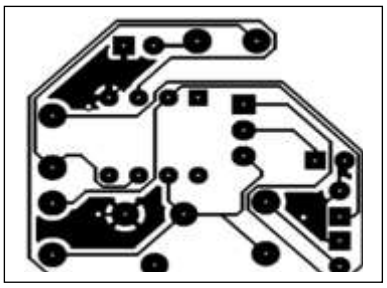

Figure 7. Gerber file schematic

Conclusion: This project fulfills all the hygiene needs and is very useful in this pandemic period. The aim of this project was 1.Your hand once placed under the dispenser, gets sensed by the IR sensor and drops the sanitizer. 2. Once the sanitizer in the bottle gets over it quickly informs the owner for the refill through the detector. These aims are met hence maintaining hygiene and preventing re-contamination.

Future scope: The future generations are much more susceptible to new strains of germs which are already present in the environment through different mutations for which the treatment won't be available sooner. Hence prevention is the only way to fight against the emerging diseases. These sanitizer dispensers can be modified according to the usage in the future times to battle in the times of need. These can be installed in public places such as supermarkets, bus stands, shops and other places which are susceptible to surface touches. This automatic self dispensing sanitizer can be installed outside the gates or doors of establishments with the opening of the gates/doors in synchronisation. This will make sure that the users sanitize themselves before entering ensuring more safety. The health and wellness industry can implement these sanitizer dispensers in their vicinity of functioning for a more healthy environment.

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